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Storage and retrieval unit

The invention relates to a storage and retrieval unit for storing and removing from store containers or pallets belonging to a rack, having at least one endless drive element which is led around two wheels arranged at a distance from each other and has an upper run and a lower run and on which at least one gripping means for gripping a container or a pallet is arranged.

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Storage and retrieval units of this type are known for picking up and depositing loads in racks. The storage and retrieval unit is arranged on a vehicle which, for example, can be moved horizontally and vertically on rails between racks. Using the storage and retrieval unit, containers or pallets are loaded onto the vehicle and put into store from the vehicle at the envisaged storage space in the rack. Important in such storage and retrieval units are a high throughput, a low demand for space and the greatest possible precision when picking up and depositing the containers or pallets.

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A storage and retrieval unit of the aforementioned type has been disclosed by WO 01/10751 from the applicant. This has gripping arms which are inclined with respect to the pulling direction of the endless drive element and which each have a cam which moves into a vertical groove in the pallet in order to grip a container or a pallet. As a container or a pallet is gripped, the cam moves into the groove from below. As the container or the pallet is deposited, the cam moves upward out of the groove again. In practice, the storage and retrieval unit has proven to be extremely worthwhile. For this storage and retrieval unit, an appropriate container or a pallet which has the aforementioned appropriate adapted groove is necessary. Previously usual containers cannot generally be used here.

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EP-A-0 322 313 discloses a storage and retrieval unit in which a gripping means is likewise provided which, at an outer end, has a cam which moves into a groove in a container. Commercially available containers or
5 pallets cannot be used in this storage and retrieval unit either. This is likewise true of the storage and retrieval unit according to DE-A-195 01 893. DE-A-42 33 690 discloses a storage and retrieval unit in which, in order to grip a container, a gripper engages fully
10 in a groove in the container. This storage and retrieval unit can only be moved vertically between stored containers, since it would collide with the containers in the event of a horizontal movement. In addition, this storage and retrieval unit also requires
15 a specific container.

The invention is based on the object of providing a storage and retrieval unit of the aforementioned type with which even commercially available containers or
20 pallets can be stored and removed from store. The storage and retrieval unit is additionally to be constructionally comparatively simple and capable of being produced economically. Nevertheless, the storage and retrieval unit is to be functionally reliable.

25 In a storage and retrieval unit according to the invention, the object is achieved in that the gripping means is formed in the manner of tongs and is guided in such a way that it carries out a lateral movement in
30 order to grip a container or a pallet. Using such a storage and retrieval unit, any container or any pallet that has a protruding rib or depression at the side can be handled. By far the majority of containers have such ribs, at least on the sides, which are used here
35 as a stiffening rib. In principle, however, a frictional connection to the container is also possible, so that even containers that are flat on the outside can be stored and removed from store.

According to a development of the invention, the gripping means has two arms mounted at a distance from each other, which carry out a pivoting movement when gripping and depositing a container or a pallet. According to a development of the invention, this pivoting movement is controlled by means of at least one rail which is fixed to a frame of the storage and retrieval unit. Two such rails are preferably provided, one rail controlling a first gripping means and the second rail controlling a second gripping means. The first gripping means grips a container on the pallet in order to load it onto the storage and retrieval unit, and the second gripping means pushes the container off the storage and retrieval unit, for example into a store. Once the container or the pallet is on the storage and retrieval unit, it is guided by both gripping means.

According to a development of the invention, the gripping means has two gripping arms, the movement of one gripping arm being transmitted to the other gripping arm by means of a tie rod. The two gripping arms are additionally preferably mounted on a common connecting rod. This results in a simple and nevertheless stable and reliable construction.

According to a development of the invention, the gripping means in each case have at least one rod which is positioned in such a way that it pushes the container as the latter is deposited.

Further advantageous features emerge from the dependent patent claims, the following description and the drawing.

An exemplary embodiment of the invention will be explained in more detail in the following text by using the drawing, in which:

- 5 figure 1 shows in schematic form a three-dimensional view of a storage and retrieval unit according to the invention with a container,
- 10 figure 2 shows the view according to figure 1 but without a container,
- figure 3 shows in schematic form the gripping of a container,
- 15 figure 4 shows a front view of the storage and retrieval unit with a container,
- figure 5 shows a three-dimensional view of a gripping means,
- 20 figure 6 shows a further view of the gripping means according to figure 5,
- figure 7 shows a further view of the gripping means,
- 25 figure 8 shows a section of an endless drive element,
- figure 9 shows a further view of the section according to figure 8,
- 30 figure 10 shows in schematic form a view of the endless drive element having two gripping means and
- figures 11a to 11e
- 35 show in schematic form individual steps when pulling a container onto the storage and retrieval unit.

The storage and retrieval unit 1 shown in figure 1 is mounted on a vehicle, not shown here, which can be moved in gangways in a rack in order to pick up and deposit at least one container 2. The vehicle can also have a plurality of storage and retrieval units 1, for example two storage and retrieval units 1 arranged beside each other. In figure 1, the storage and retrieval unit 1 is loaded with a container 2. The container 2 is a normal container made of plastic and has parallel side walls 2a and a base 2b. Instead of the container 2, the storage and retrieval unit 1 can also be loaded with a pallet, not shown here. The container 2 is used to hold the goods, not shown here, which are to be put into store or removed from store.

According to figure 2, the storage and retrieval unit 1 has a frame 3 which has two crossmembers 4 to which two opposite bearing plates 5 are fixed. Mounted on the bearing plates 5 is a drive shaft 7 which is driven via a gear mechanism 8 by a motor 9, in particular an electric motor. Also mounted on the bearing plates 5 is an axle 10 on which two chain wheels 11 are fixed, around which in each case an endless drive element 13, for example a link chain, is placed. These two drive elements 13 are driven by the shaft 7, which likewise has two chain wheels 12. Also fixed to the frame 3 are two sliding rails 6, which are arranged at a distance from each other and run parallel to each other. These sliding rails 6 are L-shaped in cross section and are used to guide the container 2.

In order to pick up and deposit the container 2, the storage and retrieval unit has two gripping means 40 and 41, which are constructed substantially identically and which are fixed at a distance from each other on the two endless drive elements 13. Figure 5 shows the gripping means 40, but the gripping means 41 is constructed identically. At the ends of a loadbearing

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- rod 16 in each case a support 33 is fixed, which is in turn fixed to two fixing lugs 37, for example screwed on. According to figures 8 and 9, these fixing lugs 37 are movable connecting parts of a drive element 13.
- 5 According to figures 8 and 9, the drive element 13 is an intrinsically normal link chain. However, a toothed belt, for example, could also be used instead of the link chain 13.
- 10 On each support 33 is a gripping arm 18 and 24, respectively, which can be pivoted to a limited extent about an axle 24 and 26, respectively. By means of a tie rod 17, the two gripping arms 18 and 24 are connected to each other. The tie rod 17 is connected
- 15 to the gripping arm 24 by a rotary joint 25. The tie rod 17 is connected to the gripping arm 18 by a threaded bolt 32, which is screwed into the tie rod 17 and is fixed by a nut 34. Between the nut 34 and the gripping arm 18, a compression spring 31, which is
- 20 supported on the nut 34 and on the gripping arm 18, is arranged on the threaded bolt 32. The gripping arm 18 has a through hole 42, through which the threaded bolt 32 is pushed loosely.
- 25 Also arranged on the support 33 is a pulling element 36 which can be pivoted about a rotary bearing 27. The threaded bolt 32 passes through the pulling arm 36 and rests with a head 32a on the outside of the pulling element 36. Fixed to the pulling element 36 and also
- 30 to the gripping arm 18 by means of fixing screws 30 is a control plate 28 and 29, respectively, which in each case projects downward, as shown in particular by figure 4. These two control plates 28 and 29 interact with the control rail 19 in order to pivot the two
- 35 gripping arms 18 and 24. The other gripping means 41 interacts in the same way with the other parallel, opposite guide rail 19'.

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The guide rails 19 and 19' each have a channel 20, which is open at both ends and in which one of the two endless drive elements 13 is guided. The two gripping elements 40 and 41 are moved by the drive elements 13.

5 By means of the guide rails 19, the gripping means 40 and 41 are in each case actuated one after another in such a way that the two gripping arms 18 and 24 are pivoted from the spread arrangement shown in figure 6 in the direction of the arrows 43 into the parallel

10 arrangement shown in figure 7. This is achieved by the two control plates 28 and 29 running onto the control surfaces 21 running obliquely outward and shown in figure 6 and, as a result, being displaced in parallel. As a result, the gripping arm 18 is pivoted about the

15 rotary joint 26 and, at the same time, the pulling element 36 is pivoted about the rotary joint 27. Here, the pulling element 36 takes the threaded bolt 32 with it and, as a result, the other gripping arm 24 is pivoted into the parallel position by the tie rod 17.

20 The compression spring 31 is tensioned hereby. In the region of the guide rail 19, the two control plates 28 and 29 are placed on the outside of control surfaces 22 and 23. In the region of the guide rail 19, the two gripping arms 18 and 24 are thus aligned parallel to

25 each other, according to figure 7. At the other end of the guide rail 19, the two control plates 29 and 28 are free again and, by means of the pressure of the tensioned spring 31, these can be pivoted again into the position shown in figure 6. The two gripping arms

30 18 and 24 are therefore spread out again. As they move onto this horizontally extending guide rail 19 or guide rail 19', the gripping arms 18 and 24 execute a tongs-like closing movement. As they leave the guide rail 19 and 19', the tongs are opened again in opposing

35 movements. If the gripping means 40 and 41 are outside the region of the guide rail 19 or 19', then the gripping arms 18 and 24 are opened, according to figure 6. The aforementioned opening and closing is in each

case carried out at the ends of the guide rail 19 and 19', specifically in each case when the gripping arms 18 and 24 are aligned horizontally.

5 On the two gripping arms 18 and 24, in each case at the free end, a gripping finger 35 that projects inward is integrally molded. These gripping fingers 35 are respectively moved toward each other and away from each other as the gripping arms 18 and 24 are pivoted. The
10 distance between the gripping fingers 35 is thus reduced or enlarged. The gripping fingers 35 can be designed differently. In principle, an embodiment would also be conceivable in which the gripping fingers 35 are replaced by friction plates or magnets or the
15 like.

The operation of the storage and retrieval unit according to the invention will be explained in more detail by using figures 11a to 11e.

20 In figure 11a, a container 2 is ready to be picked up. The two gripping means 40 and 41 are located outside the region of the guide rails 19 and 19' and are therefore open according to figure 6. If then, from
25 this rest position, the endless drive elements 13 are driven in the direction of the arrow 45, the two gripping means 40 and 41 run with it in the same direction and ultimately reach the arrangement shown in figure 11b, in which these extend horizontally. The
30 gripping means 40 is in this case not yet in engagement with the guide rail 19, and the two gripping arms 18 and 24 thus remain open according to figure 6. The two gripping fingers 35 are in each case arranged in front of a rib 39 belonging to the container 2. These ribs
35 39 extend vertically and protrude laterally.

During an onward movement, the gripping means 40 then comes into engagement with the guide rail 19 and, as a

result, the two gripping arms 18 and 24 are pivoted and moved into the closed position shown in figure 7. The two gripping fingers 35 are thus moved inward toward the container 2. They ultimately engage behind a rib 39 in each case and rest on the latter. The container 2 is therefore gripped by the gripping means 40 and is finally picked up onto the storage and retrieval unit 1, until the position shown in figures 1 and 11e is reached. In the position according to figure 11d, the gripping means 41 is pivoted about the axle 10 and finally comes into engagement with the guide rail 19'. The gripping arms 18' and 24' are therefore likewise closed in the manner of tongs and finally grip the container 2 in the position according to figure 11e. The container 2 has therefore been picked up onto the storage and retrieval unit 1 and is held by the two gripping means 40 and 41. The rod 17 of the gripping means 41 bears on the rear of the container 2 in fig. 11e. During further transport, the rod 17 pushes the container 2 off the storage and retrieval unit. Once the storage and retrieval unit has been unloaded, it can be loaded with a further container. The container 2 can then be transported to the desired position by the vehicle.

In order to deposit the container 2, the drive elements 13 are moved again, so that the container 2 in figure 11e is optionally moved to the left or to the right. If the container 2 is moved to the left in figure 11e, the gripping means 40 opens first. Once the gripping means 41 reaches the drive shaft 7, this gripping means 41 is also opened and therefore the container is released. If the container 2 is moved to the right in figure 11e, the gripping means 41 opens first and finally the gripping means 40. During both tongs-like movements, the gripping fingers 35 in each case describe a circular path 38, as indicated in figure 10 by a dashed line 38. However, on account of the tongs-

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like movement of the gripping arms 18 and 24, such a circular path is not imperative. The gripping arms 18 and 24 could also be guided in parallel. The two end points of these paths are indicated by A and B in figure 10. Once the gripping fingers 35 are in the region of the end points A and B, the gripping arms 18 and 24 are aligned horizontally. Outside these positions, the gripping arms 18 and 24 and 18' and 24' extend tangentially with respect to the drive shaft 7 toward the axle 10.

In order to pick up and to deposit the container 2 as explained above, only ribs 39 or recesses which protrude laterally are required on said container. Such ribs 39 are possessed by most commercially available containers which are provided for storage frames. In principle, the ribs 39 can also be replaced by openings or depressions. In principle, it is also possible to grip the container 2 frictionally. This is required when the outer side of the container is flat. In this case, the gripping fingers 35 could be replaced by a rubber plate or the like. Finally, an embodiment is conceivable in which the gripping means 40 and 41 have only one gripping arm 18, 18' or 24, 24' in each case and the container 2 is guided on the opposite side.